Before the
Federal Communications Commission
Washington, D.C. 20554

In the matter of	)	
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Revision of Part 15 of the Commission's Rules	)	ET Docket No. 98-153
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	)	
Regarding Ultra-Wideband Transmission Systems	)	
	)	

REPLY OF THE SATELLITE INDUSTRY ASSOCIATION

SATELLITE INDUSTRY ASSOCIATION

David Cavossa, Executive Director
1730 M Street, NW
Suite 600
Washington, DC 20036

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On December 15, 2004, the Commission adopted a Second Report and Order and Second Memorandum Opinion and Order ("2nd R&O") in the above-captioned proceeding, which concerns the rules governing the operation of ultra-wideband ("UWB") devices. The Satellite Industry Association ("SIA") submitted a Petition for Reconsideration of the 2nd R&O ("Petition") on March 11, 2005, focusing on aspects of the 2nd R&O that have a potential impact on fixed satellite service ("FSS") earth stations operating in the 3700 – 4200 MHz band. Freescale Semiconductor, Inc. ("Freescale") filed an opposition to the Petition ("Opposition") on June 30, 2005, and SIA hereby replies to Freescale's Opposition.

Introduction and Summary

In its Petition, SIA presented a significant amount of new information, including information from studies conducted within and outside the ITU, showing that the interference standards that the Commission has adopted for UWB devices are inadequate to protect C-Band satellite downlinks. In its Opposition, Freescale addressed: a) whether SIA's Petition is barred on procedural grounds or the Commission lacks the authority to address the merits of SIA's Petition, b) SIA's recommendation that an interference-to-noise ("I/N") ratio of -20 dB be used to establish criteria for protecting FSS systems operating in the 3700 – 4200 MHz band against interference from UWB devices, c) a technical analysis submitted by the United Kingdom to the ITU that SIA relied on in its Petition, and d) a technical analysis prepared by Alion Science and Technology ("Alion") that SIA also had relied on. Freescale's Opposition presents no basis for ignoring this

information or failing to adjust the UWB rules to take the information into account.

Freescale's procedural and jurisdictional objections are misplaced. On the procedural front, Freescale claims that "nothing in the petition challenges any decision made in the [2nd R&O]," even though Sections III and IV of the Petition clearly address the analysis in the 2nd R&O of a study submitted by Alion Science and Technology. On the jurisdictional front, Freescale argues that the Commission "lacks jurisdiction" to set aside the 30-day time period for filing reconsideration petitions and thereby lacks jurisdiction to consider SIA's Petition, even though (1) the Petition was filed within 30 days of the date of public notice of the 2nd R&O; (2) the Commission routinely considers "late-filed" but pertinent information in rulemaking proceedings, just as it considered the Alion study in the 2nd R&O; and (3) the Commission held the record open in this proceeding for the express purpose of considering new information relating to the issue of UWB interference to C-Band FSS downlinks.

Freescale, moreover, does nothing to refute the technical analyses presented in the Petition. In some cases, Freescale criticizes the analyses presented in a general way, but never identifies specifically what it believes to be wrong with the analyses. In other cases, Freescale's objections are simply off the mark. For example:

- Freescale's objections to an interference to noise ratio of -20 dB conflict with an ITU recommendation that the U.S. government has supported.
- Freescale claims that the studies used to demonstrate that the Commission should revise its UWB emission limits to provide C-band FSS operators with an I/N protection level of -20 dB are based on worst case conditions, when in fact the studies are based on normal satellite link budget conditions that are the same as those proposed by the United States in submissions to the ITU.
- Freescale objects to SIA's reliance on ECC Report 64, but did not cite to or analyze a single finding in the report.
- Freescale questioned whether the results of a U.K. study relied on by SIA could be replicated even though all of the relevant inputs appeared in the study.

- Freescale assumed that the U.K. study took into account sample points at which there was building amplification, when in fact it did not consider such points.
- Freescale argued that the study should have assumed there would be exclusion zones around C-band earth stations, even though nothing in the FCC's rules or otherwise precludes a UWB device from operating in close proximity to an earth station, and even though in cases in which the study did include exclusion zones the same conclusions have been reached.
- Freescale criticized densities and activity factors in the U.K. study that are in keeping with ITU and industry figures.
- Freescale criticized a parameter sensitivity analysis in the U.K. study that is based on standard technical procedures.
- Freescale did not respond to an *ex parte* filing by Fox/HBO demonstrating that the Commission's concerns with the Alion Study were misplaced.
- Freescale criticized the density level used in the Alion Study, but provided no density level analysis of its own.
- Freescale criticized the Alion Study for using elevations for UWB devices that would be typical for many suburban areas.
- Freescale criticized the assumption in the Alion Study that a portion of the UWB transmitters would unobstructed transmission paths even though making such an assumption is a standard and accepted practice.

The potential for interference to C-band downlinks is an issue of serious concern to SIA's members, many of whom use the C-band to provide commercial and military customers with important communications services requiring a high degree of reliability. Given the importance of these services and the accumulating body of evidence showing that the current rules expose C-band downlinks to serious levels of interference, the Commission should disregard Freescale's objections and reexamine its UWB interference standards.

Discussion

1. SIA's Petition Is Not Barred On Procedural Grounds And The Commission Has The Authority To Consider The Issues Raised In SIA's Petition

1.1 Freescale's Procedural Objection

Freescale argues that SIA's Petition for Reconsideration is barred on procedural grounds, claiming that "[n]othing in the petition challenges any decision made in the Second Report and Order."[1] This claim is plainly incorrect. Sections III and IV of SIA's Petition address the Commission's analysis in the 2nd R&O of a study performed by Alion Science and Technology (the "Alion Study") that was submitted by the Coalition of C-Band Constituents.[2] Section III of the Petition for Reconsideration demonstrates that the Commission, in its analysis in the 2nd R&O,[3] misconstrued several key elements of the Alion Study. Section IV shows that the complaint procedures contemplated in the 2nd R&O[4] are ineffective to protect C-band FSS earth stations against interference caused by UWB devices. Given that SIA's Petition directly addressed elements of the 2nd R&O, Freescale's procedural argument, insofar as the Alion Study is concerned, should be rejected.

1.2 Freescale's Jurisdictional Objection

Freescale claims the Commission "*lacks jurisdiction* to set aside the 30-day time period for filing reconsideration petitions."[5] This claim also is plainly incorrect, and misconstrues the situation at hand.

The cases cited by Freescale involve situations in which a Petition for Reconsideration was filed more than 30 days after the most recent action taken by the Commission. SIA's Petition for Reconsideration, on the other hand, was filed within 30 days of the date of public notice of the 2nd R&O.

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1 Opposition to Petition for Reconsideration of the Satellite Industry Association filed by Freescale Semiconductor, Inc., June 30, 2005, at 1-2 ("Freescale Opposition").

2 Alion Science and Technology, *Evaluation of UWB and Lower Adjacent Band Interference to C-Band Earth Station Receivers*, Feb. 11, 2004, *ex parte* filing by Coalition of C-Band Constituents, ET Docket Nos. 98-153 & 02-380, Feb. 18, 2004.

3 2nd R&O, ¶¶ 95-99.

4 2nd R&O, ¶ 99.

5 Freescale Opposition at 2 (emphasis added).

Most of the cases cited by Freescale, moreover, involve situations in which the Commission action in question is in a non-rulemaking proceeding that is subject to Section 1.106 of the Commission's rules. SIA's Petition, however, was filed in an open rulemaking proceeding that is subject to Section 1.429 of the Commission's rules. The Commission takes a more liberal attitude toward entertaining new information in open rulemaking proceedings than it does in non-rulemaking proceedings, because the rationale for refusing to consider "late-filed" petitions is different in one than in the other. In non-rulemaking proceedings, strict adherence to deadlines serves the need for finality for the individual parties involved. In rulemaking proceedings, on the other hand, the Commission routinely considers pertinent information regardless of when it was filed – as illustrated by the large number of *ex parte* filings in most rulemaking proceedings.

In this very proceeding, for example, the Commission considered the merits of the Alion Study even though it was not filed within 30 days of the date of public notice of the Memorandum Opinion and Order ("MO&O").[6] Yet, according to the logic employed by Freescale, the Commission would have *lacked jurisdiction* to consider the merits of the Alion Study regardless of its significance to issues at hand.

Finally, Freescale overlooks the fact that the Commission expressly left open the record in this proceeding on the C-band interference issue. In the MO&O, the Commission stated:

> [W]e intend to monitor closely the development of UWB devices and operations and will continue to examine interference issues as UWB products develop. We also intend to work with the FSS industry in developing an appropriate plan to perform further interference tests of UWB devices, including their potential impact on the reception of satellite signals. If our tests *or other sources* provide any indication that our standards are not adequate to protect any of the authorized

[6] 2nd R&O ¶¶ 95-99 & n.234.

> radio services from harmful interference, we will take the appropriate action to protect those services.[7]

As discussed below and in SIA's Petition, a significant amount of new information, including ITU and CEPT studies, calls into question the interference standards for UWB devices that the Commission has adopted. Particularly in light of the statement quoted above, the Commission has ample authority to take into account new information that is pertinent to its interference standards for UWB devices. Accordingly, Freescale's claim that the Commission lacks jurisdiction to entertain new information should be rejected.

2. I/N of -20 dB

Freescale opposed SIA's proposal that the Commission revise its UWB emission limits so as to provide FSS operators with an I/N protection level of -20 dB in the 3700 – 4200 MHz band instead of an I/N protection level of 0 dB. Based on the fact that SIA takes issue with employing a "harmful interference" standard in these circumstances, Freescale claimed that SIA is seeking protection against UWB emissions that only "slightly" reduce the margin of an FSS link. Freescale also asserted that a -20 dB I/N protection level only can be justified if it is assumed that all worst-case conditions anticipated in the link budgets occur simultaneously and if real-world attenuation factors are ignored. Finally, Freescale questioned the validity of the findings in ECC Report 64. SIA refutes each of Freescale's assertions below.

2.1. Freescale's Arguments Conflict With An ITU Recommendation That The U.S. Government Has Supported

SIA showed in its Petition that an I/N level of 0 dB conflicts with Recommendation ITU-R S.1432, which the U.S. administration supported.[8] Freescale's Opposition is silent on this point.

Recommendation ITU-R S.1432 provides guidelines for minimizing the impact of emissions from non-primary services to fixed satellite services and

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[7] *Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems*, Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, FCC 03-33, ¶ 131 (Mar. 12, 2003) (emphasis added).

[8] Petition at 5.

space stations. An I/N level of -20 dB is consistent with the recommendation in ITU-R S.1432 that interference to be allotted to all non-primary sources be set at 1% of total noise. An I/N level of 0 dB, on the other hand, exposes C-band FSS downlinks to 100 times the level of interference from UWB devices than would be the case under Recommendation ITU-R S.1432 (*i.e.*, 100% of the total noise instead of 1% of the total noise).[9] Freescale has provided no justification for exposing C-band FSS downlinks to interference that is 100 times the level recommended by the ITU.

2.2. Harmful Interference Is Not an Appropriate Benchmark

In its Opposition, Freescale asserts that SIA is seeking protection against UWB emissions that only "slightly reduce" the margin of C-band FSS links.[10] Freescale bases this assertion on the fact that SIA has opposed application of the "harmful interference" standard to UWB emissions.

Freescale has mischaracterized SIA's position. SIA opposes use of the harmful interference standard in these circumstances because it would - by definition - permit large numbers of UWB devices to interfere up to the point that they cause serious degradation to C-band FSS downlinks.[11] Permitting new unlicensed services to cause such degradation to licensed services is inconsistent with the principle that unlicensed services should not interfere with licensed services.

SIA demonstrated in its Petition that the interference that is permitted under the rules the Commission has adopted can have a catastrophic impact on typical satellite links. SIA provided a detailed analysis in Exhibit 2 of its Petition showing how in many cases these levels of interference would cause FSS links to collapse.[12] By any fair measure, interference that causes a link to collapse is doing far more than "slightly reducing" the margin for the link.

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[9] *See* Petition at 5.

[10] *See* Opposition at Technical Statement, p. 1.

[11] *See* 47 C.F.R. § 15.3(m) (defining "harmful interference" as "[a]ny emission … that … seriously degrades … a radiocommunication service operating in accordance with this chapter."

[12] *See* Petition at 7 and Exhibit 2.

2.3. SIA's Proposals Are Not Based On Worst-Case Link Budget Assumptions

Freescale asserts that SIA's support for an I/N level of -20 dB is based on an assumption that all possible worst-case conditions will occur simultaneously. Freescale did not, however, specify which worst-case conditions it had in mind or provide the set of conditions it believes correspond to "normal" operations. Rather, Freescale limited itself to generalities. Given these circumstances, it is not possible to draw any meaningful conclusions from Freescale's argument.

In any event, SIA notes that the link budget contained in Exhibit 2 of SIA's Petition takes into account the constant long term interference effects from other adjacent satellites. This is not a worst case condition, but a real and long term condition that FSS operators and their customers have to account for in their link design. Moreover, all satellite operators go to great lengths to coordinate their various emissions (with each other) in order to "manage" the interference impact from adjacent satellites.

In addition to adjacent satellite interference, satellite link performance is further degraded by intermodulation interference when multiple (narrow-band) carriers are transmitted through a single transponder. This effect is known and accounted for as appropriate. Lastly, all satellite links include an additional margin to account for other known (and unknown) sources of degradation, such as variation in propagation conditions and equipment aging. Most operators include a link margin of approximately 1 to 2 dB to account for such effects. Incorporation of greater margins generally lead to the need to use large receive antennas, which in turn can lead to unacceptable earth station costs for the customer.

Moreover, as explained in the Petition, the link analysis contained in Exhibit 2 of SIA's Petition was based upon an analysis submitted to meetings of ITU Task Group 1/8 by the U.S administration. In particular, all link budget assumptions are those contained in the document submitted to the ITU by the U.S. administration.

The link analysis contained in Exhibit 2 of SIA's Petition determined the effect on a satellite link from an additional source of interference having a power equal to the noise power of the receiver, i.e. under an I/N = 0 dB as used by the Commission in the derivation of the current limits. The result

was that the link is degraded by more than 2 dB, thus eating through any additional margin built into the link and resulting not in a "slight" reduction of the link margin, as asserted by Freescale, but in the complete interruption of the link.

2.4. The Conclusions of ECC Report 64 Challenged by Freescale Were Also Reached by the ITU Task Group Studying UWB Matters

In its Opposition, Freescale also took issue with SIA's reliance on ECC Report 64. This report detailed the results of the analytical work conducted in Europe concerning UWB technical standards and regulations.

Freescale claimed that there were "significant technical problems" with ECC Report 64.[13] Freescale did not, however, cite to a single finding in the report, much less identify why it believed that there were technical problems with the findings. Similarly, Freescale offered no support for its claim that critical analyses had been "summarily rejected on political grounds."[14] Freescale's unsupported generalizations are entitled to no weight. The results contained in ECC Report 64, moreover, are fully consistent with the results provided by another international technical group, ITU Task Group 1/8, in which the United States is an active participant.

In summary, studies generated after the Commission adopted its rules for UWB devices demonstrate that in order to adequately protect FSS earth stations in the 3700 – 4200 MHz band, the Commission needs to use an I/N ratio of -20 dB. Furthermore, these studies are not based upon worst case conditions, as asserted by Freescale, but rather are based upon normal satellite link budget conditions that are the same proposed by the United States in recent submissions to ITU meetings.

3. The U.K. Technical Analysis

In its Opposition, Freescale claimed that there were deficiencies in the technical analysis that was submitted by the administration of United Kingdom to ITU-R Task Group 1/8 and that was reproduced as Exhibit 3 of SIA's Petition. The U.K. contribution contained the results of numerous simulations with aim of determining the I/N level that an FSS receiver

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13 Opposition at Technical Statement, p. 1.

14 Opposition at Technical Statement, p. 1.

would be subject to as a result of UWB devices operating with emission levels of -41.3 dBm/MHz – the level currently authorized by the Commission. This section addresses each of the issues raised by Freescale regarding the U.K. study.

3.1. The U.K. Document Provides Sufficient Information For Its Results to Be Replicated

Freescale questions whether there is sufficient information in the U.K. study to replicate the results of the study. In fact, all of the pertinent input information is contained in the document. The document clearly specifies the FSS receiver characteristics, the statistical distribution of UWB devices within the study area, the propagation equations used to derive the path loss from an individual UWB device to the FSS receiver, and the statistical distribution that was incorporated in the simulations for building attenuation.[15] Accordingly, there is no basis for Freescale's claims concerning the sufficiency of the information in the U.K. document.

3.2. Assumptions Pertaining to Path Loss

Freescale claims that the use of probabilistic distribution for building losses could lead to cases where there is building "amplification". SIA agrees that the U.K. document does not make this point clear but would like to clarify that during the simulation any sample point corresponding to building "amplification" has been disregarded. In this respect, SIA agrees that in the U.K. document the statistical distribution of the building penetration loss should have been characterized as a log-normal distribution with a mean of 10 dB and a standard deviation of 5 dB, truncated at 0 dB, rather than as a conventional log-normal distribution. Therefore, the fears expressed by Freescale that the results presented might have been distorted by sample points that would have been associated with a building "amplification" are not justified.

Further, Freescale asserts that for outdoor UWB emitters, the U.K. study made no attempt to allow for attenuation due to blockage. This statement is incorrect. As clearly stated in Section 2 of the document, the study

[15] This contribution was discussed by ITU-R Task Group 1/8, which Freescale participates in, and its results have been included in the most recent outcome documents from this Task Group. *See* ITU-R Document 1-8/152, "FSS/Ultra-Wideband Compatibility - Aggregate Interference Studies in the Space-to-Earth Direction", contribution from the administration of the United Kingdom, 2 June 2004.

incorporated $1/r^2$, $1/r^3$ and $1/r^4$ path loss factors. These factors are commonly used by RF engineers to account for line of sight path loss ($1/r^2$), losses through trees and foliage ($1/r^3$) and losses associated with an urban environment ($1/r^4$) that includes attenuation due to densely populated building structures.

3.3. Assumptions Pertaining to Exclusion Zones

Freescale asserts that all but one of the plots that are contained in the U.K. study assumed an exclusion zone – an area where UWB devices would not be deployed – of 0 meters. Consequently, according to Freescale, devices placed "unrealistically close" to the FSS receiver will dominate the aggregate (interference) effects upon a victim FSS receiver.[16]

There is nothing in the rules the Commission has adopted, however, that limits how close an unlicensed UWB device can be to an FSS receiver or the otherwise establishes an exclusion zone around an FSS receiver. In the absence of such limits, it is necessary and appropriate that UWB emission limit account for a variety of realistic UWB distribution scenarios such as those described in the U.K. study.

In any case, Figure 8 in Exhibit 3 of the Petition shows that the interference concerns expressed by SIA hold true even for unrealistically large exclusion zones (separation distances at least as large as 200 m).

3.4. Assumptions Pertaining to the Number of Active Emitters

Freescale asserts that the U.K. study did not use "realistic" UWB device densities and duty cycles simultaneously. In the study, the effect of various densities of simultaneously active, co-frequency UWB devices on the overall I/N of a victim FSS receiver was determined. As discussed below, however, these densities of active devices correspond to realistic combinations of device densities and activity factor.

For the outdoor interference scenario, Figure 3 in Exhibit 3 considered four outdoor active device densities 0.01, 0.1, 1 and 10 active devices per square kilometer (e.g. 1, 10, 100 and 1000 devices per square kilometer with an activity factor of 1%).

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[16] Opposition at Technical Statement, p.3.

For the indoor scenario, the simulation assumed a UWB device density of .0017 active devices per square meter for residences and a density of .005 active devices per square meter was assumed for five-story residential "hot spots." From the description of the model given in the U.K. document it can be concluded that this corresponds to approximately 320 active devices per square kilometer. This number is smaller than that proposed in the output of the most recent ITU Task Group 1/8 meeting for aggregate interference studies associated with urban areas.[17] Task Group 1/8 suggests that for urban areas a density of 10,000 devices per square kilometer combined with an activity factor of 5%, i.e. 500 active devices per square kilometer, be used. These densities are also consistent with the more recent industry predictions of more than 140 million UWB electronic products by 2009.[18]

3.5. The Parameter Sensitivity Analysis Conducted in the ITU Study Is Appropriate

Freescale criticizes the U.K. study for varying only one parameter over a range while holding the other parameters unchanged at their worst case value. As an example, it notes that the U.K. study varies the antenna elevation over a range of values while holding the exclusion zone and device density at worst-case values.

The methods utilized in the U.K. study, however, are based on standard technical procedures used by engineers and scientists. In a multi-parameter problem, it is standard practice to vary one parameter at a time, while holding the other parameters unchanged, in order to observe the parameter's impact on the output. Accordingly, Freescale's argument is unfounded.

In summary, the criticisms of the U.K. study made by Freescale are incorrect, misleading and unsubstantiated. The study is based upon a proper and reasonable set of assumptions, and presents a comprehensive analysis on the impact of emissions from UWB devices on an FSS receiver operating in the 3700 – 4200 MHz band.

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[17] See Section 4.4.1 of ITU-R Document 1-8/347, "Annex 5 to TG 1/8 Chairman's Report", 17 June 2005.

[18] Wall Street Journal, June 16, 2005, quoting results of a study conducted by UWB chip maker Alereon Inc.

4. Alion Study

On February 2004, Alion conducted an extensive study on behalf of the Coalition of C-band Constituents (the "C-band Coalition") to determine the impact of UWB devices on FSS receivers operating at C-band frequencies. In its Opposition, Freescale takes issue with the portions of SIA's Petition supporting the Alion Study. In this section, SIA provides its response.

As an initial matter, SIA notes that in an *ex parte* filing dated June 30, 2005,[19] Fox Broadcasting Company/Fox Cable Networks and Home Box Office responded to questions that had been raised in the 2nd R&O concerning the methodology used in the Alion Study. This filing, which Freescale did not respond to, and which SIA hereby incorporates by reference, establishes that the Commission's concerns with the methodology were misplaced.

Freescale asserts that for Gaussian distribution of UWB devices, the average device density will be unrealistically high in areas close to the FSS receiver – far higher than the average density levels cited by SIA in its Petition. Freescale never articulated, however, what it considered an "unrealistic" device density level to be. Similarly, Freescale gave no indication what it believed a "realistic" device density level would be or make any effort to justify its belief. Given this lack of specificity, Freescale's assertions should be disregarded.

SIA acknowledges that for a Gaussian distribution the UWB device density would be higher as one gets closer to the FSS receiver – with the actual device density at any given distance from the FSS receiver being unknown. Despite the fact that Alion incorporated a 30 meter exclusion zone, however, which is not a requirement under the FCC's rules, the aggregate effect of UWB devices produced unacceptable level of interference to the FSS receiver. Even uniform distributions, moreover, were shown to produce deleterious results from UWB operations. In reality, no one knows how UWB devices will be distributed within the population. Accordingly, a Gaussian distribution model (with its associated device densities) is just as likely as a uniform or inverse Gaussian models or even some other distribution model.

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[19] *See* letter from Benjamin J. Griffin and Christopher R. Bjornson, counsel for HBO, and John Quale, counsel for Fox Broadcasting Company/Fox Cable Networks, to Marlene H. Dortch, FCC.

Freescale asserts that SIA's claim of interference with a uniform UWB device distribution is based on flawed results for just one of the three receiver models. SIA notes that there were five receivers that were considered by Alion. Of those five receivers, interference from UWB devices distributed uniformly would cause unacceptable interference to the FSS-8PSK receiver as well as FSS-QPSK2 receiver, which use FEC rates of 8/9, and 7/8. These types of receivers usually have higher C/N requirements and are much more sensitive to interference when compared to the other two digital receivers considered in the Alion Study – FSS-QPSK1 and FSS-QPSK3. These latter two receivers use FEC rates of 3/4. Hence, it is not surprising that FSS-QPSK2 and FSS-8PSK were much more sensitive to interference from UWB emissions than the other two digital receivers.

Freescale argues that the Alion Study overestimates interference into FSS receivers from UWB devices, primarily because the study places a small number of UWB devices high in the air for which only free space path loss is assumed. Furthermore, Freescale claims that this tiny fraction of the modeled UWB devices is responsible for the vast majority of the interference power seen by the C-band receiver in the simulations. In support, Freescale refers to Motorola's submission of April 9, 2004.

Freescale overlooks the fact that operation of UWB devices located in the near vicinity of a C-band receiver at elevations many tens of meters above ground is a highly realistic situation. This corresponds to those cases in which the UWB emitter is operating in a multi-story apartment complex which typically have an open air area, e.g. balconies. Such UWB devices are not "hovering" in mid-air.

In addition, a typical suburban area consists of a mixture of low level (one or two story) houses, open areas and multi-story buildings, *e.g.* offices and apartment complexes. In a suburban setting, it is typical to find many street blocks of (one or two story) houses followed by one or more multi-story apartments and condominiums. In such an environment, it is probable that UWB transmitters operating on non-ground level units of a one or multiple apartment complexes will have clear, unobstructed views of the victim C-band receiver (because there will be only low lying houses between a UWB transmitter and a C-band receiver).

With the Fresnel zone at C-band frequencies being less than 10 meters for a 5 kilometer path, and with the Fresnel radius decreasing as the path length decreases, there would be no obstructions that would encroach into the Fresnel zone that would warrant the use of a non-free space ($1/r^2$) propagation factor. Moreover, a UWB transmitter being operated from the balcony of an apartment complex would not be subject to any additional building loss. Given this typical suburban situation, it is likely that there will be numerous cases of direct line of sight, free-space propagation.

As a further example that line of sight propagation is not an atypical case, one only needs to look at existing terrestrial microwave links. For such links, engineers typically place their transmit and receive antennas at suitable heights above ground to achieve a clear line of sight and ensure that there are no obstructions inside the first Fresnel zone along the path. Once such conditions are achieved, the signal strength along the path is calculated under the assumption of free-space path loss using $1/r^2$ – not $1/r^3$ or $1/r^4$. Accordingly, a UBW transmitter and the victim C-band FSS receiver need not be located in a desert to be in line of sight of each other with the signal degrading in accordance with a free-space propagation loss factor.

The Alion Study did not pre-suppose any specific operational environment. It simply indicated, through the use of probabilities, that a portion of the UWB transmitters, whether elevated or not, will have transmission paths that will be completely unobstructed (towards the C-band receiver), and others will be obstructed and further attenuated due to foliage or building blockage, whereby it used path loss factors of $1/r^2$, $1/r^3$ and $1/r^4$ for each of the respective three path conditions. That is standard and accepted practice.

Exclusion of direct line of sight free-space propagation as part of any standard aggregate interference analysis, as suggested by Freescale (and Motorola) is poor engineering practice and leads to skewed and inaccurate results that underestimates the expected signal strength at the target receive point. Freescale (and Motorola) are seeking to remove data points that they do not like and only retain those that support their position. Based on Freescale's (and Motorola's) comments, no elevated UWB transmitter would be subject to a path loss factor of $1/r^2$, but only to path loss factors of $1/r^3$, or $1/r^4$ or factor between these two latter values, which corresponds to an urban (or city) environment or a heavily wooded environment. That is an unrealistic assumption to make since it excludes other highly probable deployment scenarios.

For all of the foregoing reasons, Freescale's arguments concerning distribution and path loss should be rejected.

Respectfully submitted,

SATELLITE INDUSTRY ASSOCIATION

David Cavossa, Executive Director
1730 M Street, NW
Suite 600
Washington, D.C. 20036

July 20, 2005